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ABSTRACT

Network analysis, a research methodology that uses interpersonal relationships as the unit of analysis in identifying communication structures, was used in a study of college classroom communication to determine what communication network factors were associated with student grades. Questionnaires asking for student perceptions of their communication relationships were completed by 155 lower division and 87 upper division college students. The questionnaire asked students to estimate the frequency of their contact with each student in the class about course-related information and noncourse-related information. Course grades were elicited from instructors. The results showed that the less active a student was in a communication network, the better were his or her grades. (FL)

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STUDENT NETWORK FACTORS AND CLASSROOM PERFORMANCE

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Introduction

Network analysis is a research methodology utilizing interpersonal relationships as the unit of analysis which seeks to identify the communication structure in a system. The goal is to discover interconnected individuals who are linked by patterned communication flows and to correlate certain network structures with factors such as success, productivity, or satisfaction (Rogers & Agarwala-Rogers, 1976).

One area in which network analysis has been widely used is in the study of organizational communication. In early studies conducted by Jacobson and Seashore (1951), sociometric data were gathered from officials in the United States office of Naval Research in an effort to better understand their communication behavior. Follow up research was conducted by Weiss and Jacobson (1955) and Weiss (1956) to discover the informal communication networks in the organization, subgroupings which occurred, and individuals which linked groups together. More recently, network analysis has been used as one of the primary instruments included in the ICA Communication Audit designed to analyze communication behavior in an organization. Specific communication roles such as group member, isolate, liaison, and bridge have been identified, each with clearly identified characteristics and each serving a unique communication function in the organization (Monge & Lindsey, 1974). The results of network analyses in large, complicated organizations have not only identified the pathways through which information flows but also have been used to compare the formal organizational chart to the more spontaneous, informal communication identified in the network analysis, to

determine potential bottlenecks and sources of information restriction, and to provide an information base to help an organization operate more effectively and efficiently (Goldhaber, 1979).

Network analysis and sociometric choice is a methodology which has also been used in the classroom. Most of these studies are modeled after Moreno's landmark research investigating the friendship patterns of students in elementary school (Moreno, 1953; Moreno & Jennings, 1960). Glidewell, Kantor, Smith, and Stringer (1966) reviewed much of this early research which sought to determine the extent to which individual students are accepted by their peers and to analyze the social structure of classroom groups. Subsequent research has continued to focus on the elementary and secondary student, assessing the relationship between sociometric choice and factors such as achievement (Muma, 1965; Yellott, Liem, & Cowen, 1969), self concept (Videbeck, 1960; Guardo, 1969), class participation (Ahlbrand & Hudgins, 1970), race (Singleton & Asher, 1977; Shaw, 1973; Bartel, Bartel, & Grill, 1973; DeVries & Edwards, 1974), sex (Bonney, 1954; Gronlund, 1953), and open versus traditional classroom structures (Hallinan, 1976).

Speech communication researchers have also sought to explain classroom performance (Kibler, Kelly, Gibson, & Gruner, 1968; Judd & Smith, 1969; Wall, 1970; Burgoon, 1971). Only one study investigated the relationship between network variables and performance (Hurt & Priess, 1978). This latest research described how communication apprehension seemed to be evidenced in network patterns and how these patterns might have influenced middle school performance.

The Nature of Communication Networks and Student Networks

Communication networks describe a systen of relationships. All communication is essentially relational (Miller & Steinberg, 1975, pp. 46-52), and messages are constructed to have meaning in a relational context. The construction of a message is determined by the participants' perceptions of the relationship believed to exist between themselves. Although participants' perceptions may initially differ, as communication progresses the perceptions converge (Rogers & Kincaid, 1981, pp. 31-78) and participants achieve a necessary level of coordination about their relational perceptions.

The pragmatic significance of a message is determined by the perceived meaning of the message as part of a pattern of messages. Convergence is evidenced by an interdependent pattern of messages. If perceptual co-orientation is present, messages will become more and more dependent on what preceded and followed them. Episodes become more structured and predictable. Feedback, a response that elicits a response, is the minimal behavioral evidence of such development. Feedback is the necessary condition for communication between participants.

There are levels of perceptual co-orientation and behavioral interdependence. Minimal behavioral interdependence is evidenced in turn-taking, and minimal perceptual co-orientation is evidenced by agreement that a relationship does, in fact, exist. Although episodes and the perception of episodes may progress from cultural to intimate levels, if one turn did not elicit another turn or if one participant did not agree that some communication had occurred, we do not regard the participants as having communicated with each other.

Communication networks are representations of communication relationships. If a network is to be constructed from behavioral data, researchers must first determine the level of relationships they seek to model and the level of message interdependence indicating that level of relationship. If the observations of behavior produce two levels of interdependence (e.g. turn-taking feedback and relational control feedback) then the research must: 1) model the network at the lower level of interdependence (e.g. turn-taking feedback including the higher levels of interdependence as significant only as stronger links at the lower level of analysis), 2) discard the lesser links, or 3) model two networks. Theoretical consistency and methodological correspondence are the key.

The same constraints apply to networks constructed from perceptual data. Are links defined as some intensity of agreement about the particular nature/level/content of the communication or is simple agreement that communication and/or that a particular relationship exists sufficient? Questions such as this must be answered before data are gathered.

The research presented here is based on perceptual data. We are interested in the network that emerges as a product of agreed upon perceptions, i.e. reciprocated links. We regard unreciprocated links as non-links, not as weak links (see Granovetter, 1973). Although disagreement about the nature of a link may suggest a weak tie, we regard disagreement about the very existence of a link to be more a reflection of inter-judge reliability than of the link itself. Agreement that a link exists is the minimal level of co-orientation required to assume a relationship exists and is consistent with our own model of communication.

In the past, agreed upon perceptions have been confused with reciprocal behaviors in a relationship. Reciprocal network behaviors are generally referred to as symmetrical links. The reciprocal-symmetrical and behavior-

perception confusions along with the tendency of network researchers to redefine terms and create new terms has led to considerable confusion and contradictory findings (Richards, 1980; Rogers & Kincaid, 1981). We have provided this brief theoretical rationale in order to clarify our assumptions about the nature of communication and networks.

Our decision to discard unreciprocated links is also derived from our own view of the particular phenomena we are modeling. Student networks are not the same as organizational networks. They do not emerge from assigned formal rules and begin with an imposed structure involving echelons (see Miller, 1978, pp. 595-96). Student networks, are, however, evidence of emerging social systems selectively creating some structure to human behavior (see Katz and Kahn, 1978, pp. 23-33).

Student networks are also inherently more fragile and unstable than are other networks. The people that fill social positions throughout a college career change around every four years. The networks constructed around a task (e.g. a class, a project, etc.) will dissipate at the end of a semester. What is more, such temporary social systems may vary as a function of the task and the nature of the information processed in the network.

The unique qualities of student networks attracted us to this research. Which communication network variables will predict a student's classroom performance? Do some network variables operate as universals across different classes? Are some variables better predictors of performance in certain classes? Do students at different levels of classroom performance function differently in a student network?

Network Variables

There are many network variables which could apply to this situation (see Rogers & Kincaid, 1981, pp. 220-255). The purposes of this section are to explain the variables used and to develop research questions about those variables.

Roles

As social systems develop their behavior becomes more patterned and structured. The structure of communication networks may be examined by classifying members according to their position in the structure, their roles. The most elementary classification is to determine the participants (those with at least one link to another member) and the non-participants or isolates (those members with no links).

In an organizational study, Roberts and O'Reilly (1978) found that participants were the better performers, more satisfied with their jobs and more committed to the organization. We know of students in our classes that confirm this statement. However, there are also some very active participants who perform below average and earn low grades. What is more, there exists a bookworm syndrome with some apparent isolates performing well above average.

Network subsystems are called cliques and those positions that link cliques together are referred to as bridges and liaisons. The organizational literature suggests that these linkers should achieve the best performance (see Farace, Monge, & Russell, 1977, pp. 188-191). Our own observations in the classroom again suggest that both above average and below average students may occupy these roles.

Research Question #1: Are student network roles correlated with classroom performance? Are particular roles more associated with classroom success than other roles?

Activity or Connectedness

Activity may be determined by counting the number of relationships (links) an individual has. Diffusion of innovation research has found a generally positive correlation between adoption of an innovation and connectedness (Rogers and Kincaid, 1981, pp. 228-229). Hurt and Priess (1978) found that connectedness was directly related to classroom performance in a middle school, presumably due to the intervening variable of communication apprehension. Some of our observations already mentioned led us to doubt this relationship. Perhaps the relationship is curvilinear with moderate amounts of connectedness correlating with average performance while maximally connected and minimally connected members achieve below average and above average performance.

Research Question #2: Does individual connectedness correlate with classroom performance? Are certain levels of individual connectedness more associated with classroom success than other levels?

Link Accuracy

We have already noted this research will be based on perceptual data and that we regard member estimates and the extent to which they are reciprocated as similar to judgments of inter-judge reliability. Individual members could be measured with respect to their personal abilities to accurately assess relationships. In this respect an unreciprocated link is an indication of error both for the member making the prediction and the member who did not.

Most pencil and paper tests measure the extent to which class members

are accurate about the content of their course. Would above average classroom performers also be more accurate with respect to their social relationships?

Research Question #3: Does link accuracy correlate with classroom performance? Are certain levels of link accuracy more associated with classroom success than other levels?

Quality of Information

Seldom does network research probe the quality of information that passes through links. A measure of the quality can be obtained in this study since final grades of all students will be known. Do above average students communicate with other above average students?

Research Question #4: Does the quality of information communicated correlate with student performance? Are certain levels of quality of information more associated with classroom success than other levels.

Type of Network

Most network research is descriptive. Small group networks were used as the independent variable and, although there is some evidence to suggest that organization networks vary as a function of the type of information procurred (Connolly, 1975), networks are not used as the dependent variable. There is some comparative research which displays how some factors vary across networks (Richards, 1976). The principle problem with cross network research is the lack of a generally agreed upon typology of environmental or processing conditions and the lack of a theory to adequately predict the way in which networks should vary subject to such conditions.

Salem (Gratz & Salem, 1981) has developed a general theory about the conservation of information. Generally, it claims that information is con-

served in behavior, that information processing activity will evolve to a level of complexity equivalent with the level of complexity of the information being processed. Networks which process more information or more complex information should exhibit greater complexity than networks that do not. This is essentially what Connolly (1975) demonstrated about networks.

The research presented here investigated student networks about lower level and upper level courses. At our university there is a difference in both the content and methods used in these courses. The lower division courses are primarily skills courses focusing on the application of a limited body of material. The upper division courses are designed to accomplish cognitive objectives across more complex material than in the lower level. The lower level course evaluates student recall, analysis, etc., but it also evaluates student performances. The upper level classes are generally limited to the traditional evaluations of essays, reports and tests.

Most of the research seeking to predict college student performance has been conducted in lower division courses. Networks in lower division courses should exhibit less structured complexity due to the immaturity of its members and the relative simplicity of the information processed in them. On the one hand, this seems to suggest that student networks should have a greater influence in predicting performance in upper division courses. Yet it seems reasonable to assume that freshman and sophomores may have a greater need for affiliation than juniors and seniors and so be more influenced by their network than students in upper division courses.

The question of which network will better predict can be compounded if the nature of the content in the net is considered. Surely the course content is more complex in upper division courses, but social content may be

more complex in lower division courses. Which networks are better predictors of performance?

Research Question #5: Do lower level network factors correlate with student performance differently than upper division network factors?

Research Question #6: Do course content network factors correlate with student performance differently than social content network factors?

While each of the eight network factors considered in the present study have been individually analyzed to assess its relationship with course grade, the question of which network factor or factors best predict classroom performance has not been addressed. Therefore, the following two research questions were asked:

Research Question #7: What network factor(s) (either course content or social content) is the best predictor of classroom performance in lower division courses?

Research Question #8: What network factor(s) (either course content or social content) is the best predictor of classroom performance in upper division courses?

Methods

Procedures

Questionnaires asking for student perceptions of their communication relationships were distributed to students at Southwest Texas State University approximately three-fourths of the way through the spring semester, 1979. The forms were distributed to every member of six lower division courses (Basic Speech Course and Business and Professional Speech Course) yielding an N of 155 and to four upper division courses (Communication Theory, Organizational Communication, Persuasion, and Leadership) yielding an N of 86. The six lower division courses emphasized performance and skills development with much less concern for theory. Each class had fifteen to thirty-one students. The four upper division classes emphasized theory and had little or no performance requirements. Each class had from seventeen to twenty-seven students. All the members of each class completed the forms.

The form asked students to estimate their frequency of contact with each other about two types of content: course related information and non-course related information. The forms listed all the students in the class and subjects were asked to indicate their frequency of contact about the two types of content using the following scale: 1. several times a week, 2. once a week, or 3. less than once a week. The form asked students to estimate their frequency of activity excluding contact immediately prior to, during, or immediately following class. An estimate was considered to be a link if it was reciprocated at a strength of once a week or greater. The form produced data about twenty networks (ten classes with two content networks each).

Performance and Grade

Classroom performance was determined by normalized course grades. For each section numerical final course grades (e.g. 75, 86, etc.) were obtained from each teacher of each section. The scores within a partic-

ular section were converted to standard scores with a mean of 74.5 and a standard deviation of 10. The final grades were standardized to account for grading tendencies of instructors. The use of standardized scores enabled us to make comparisons across classes. These standardized scores were used as the dependent variable in all analyses requiring interval level data.

After the total distribution of these scores across all sections was obtained they were recoded into one of three categories of performance: 1. Below average (BA), the lower 30% of the distribution, 2. Average (A) the middle 40% of the distribution, and 3. Above Average (AA), the upper 30% of the distribution. These categories were used in analysis requiring nominal level data.

Link Accuracy

Student responses to the network form were coded on a data matrix. In accordance with our assumptions about the nature of networks, we discarded the unreciprocated links to create an adjacency matrix. The number of unreciprocated links for each student was an indication of error.

The unreciprocated links were used to indicate the reliability of the overall network. In an N by N adjacency matrix, N judges (i.e. students) make estimates on N(N-1) relationships. The number of unreciprocated links divided by N(N-1) yields the percentage of error. When this number is subtracted from unity (1), the result is an indication of inter-judge reliability. Only two of twenty networks had such indexes below .80. The lowest was .67 and the highest was a .94.

The number of unreciprocated links for each subject was counted. Since this absolute number of errors may vary as a function of the number of members in a network, we converted these absolute scores to standard scores with a mean of 74.5 as a standard deviation of 10. The conversion was based on the distribution of scores for a particular network. This

allowed us to use scores of proportional error which could be considered equivalent across classes.

These standardized accuracy scores were used in analyses requiring interval level data. After the total distributions of these scores were obtained they were converted into one of three categories (High, Medium or Low accuracy) based on the same distributional proportions used for standardized grades. These categories were used for nominal level analysis.

Connectedness

A similar standardizing procedure was conducted on the indicator of connectedness. The number of links for each student was counted and converted to standard scores with a mean of 74.5 and a standard deviation of 10 based on the distribution within one net. Analysis across networks was now possible.

These individual connectedness scores were used in analyses requiring interval level data. After the total distributions of these scores were obtained they were converted into one of three categories (High, Medium or Low connectedness) based on the same distributional proportions used for standardized grades. These categories were used for nominal level analysis.

Quality of Information (Others' Grade)

The quality of information provided to any one member was determined by averaging the scores of others linked to that member. For isolates this number was set at forty (40) to create a more homogeneous distribution and reduce the likelihood of Type I error. For analyses requiring nominal data, three levels of quality of information (High, Medium, and Low) were created in a manner similar to the procedure followed for course grade, link accuracy, and connectedness.

Roles

The links for each student in each network were represented on adjacency matrices which were the basis for constructing sociograms. Three times a sociogram could be drawn directly from a matrix. Most often, however, the negopy procedure outlined by Richards (1975) was performed by hand to provide a node order from which the sociogram could be drawn. From these sociograms, net roles were identified.

Members were coded into one of ten categories which were ordered and valued according to the extent to which they contribute to network structure: The roles and the corresponding value assigned to each role are as follows: isolate (0), isolate pair (1), attached isolate (2), tree node (3), clique member (4), clique member connected to attached isolate or tree node (5), clique member connected to liason type 1 or type 2 (6), bridge (7), liason type 2 (8), liason type 1 (9).

If a member fulfilled more than one role, they were assigned the role with the highest value. These values were used in analyses involving internal level data.

Roles were collapsed into one of four categories for use in nominal level analysis. Category 1, minimally active members, consisted of all previous roles assigned values of 0 to 2. Category 2, tree nodes, contained only those valued at 3. Category 3, clique members, contained members previously valued at 4, 5, or 6. Linkers, Category 4, contained roles previously valued at 7, 8, or 9. These categories were used for nominal level analysis.

Statistics

These procedures produced one dependent variable (grade), four independent variables from course content nets (course connectedness, course accuracy, course others' grade, and course role) and four independent variables from social content nets (social connectedness, social accuracy,

social others' grade, and social role).

The four independent variables for each content network in lower division courses were correlated with grade and with each other. The four independent variables for each content net in upper division courses were correlated with grade and with each other. 3 x 3 or 3 x 4 contingency tables were constructed to investigate the possibility of non-linear relationships between each independent variable and the dependent variables. Simple r's and chi-square statistics were used to answer the first six research questions.

To answer the last two research questions, the eight network factors were treated as predictor variables for course grade, the criterion variable. Multiple regression analyses were performed separately on lower level scores and upper level scores.

Results

Tables 1-4 display the statistical results of simple r correlations. The correlations between the final course grade and the four network variables is displayed in the first row of each table. The remaining figures in each table reflect correlations between network variables. Statistically significant correlations are noted by an asterisk.

Research questions #1 through #6 were answered by using these correlational results. Contingency tables were also employed but the display of these tables would add little to the results of the answers to the questions.

Tables 1, 2, 3, and 4 about here

Research question #1 asked about the nature of the relationships between network roles and student performance. Only one of four relevant correlations were statistically significant and no significant relationship was detected at nominal level analysis. Only the social content role in lower division classes was significantly correlated to grade ($r=-.15$, $p<.05$). The course content role in lower division courses, and both the course content role and social content role in upper division were not significantly correlated to grade. There is little relationship between student network role and classroom performance.

One important characteristic of all four correlations is that they are negative, indicating an inverse relationship. What relationship there is indicates that the less involving roles are more likely to be associated with classroom success.

Research question #2 addressed the relationship between network connectedness and classroom performance. Two of the four relevant correlations were significant with both social content connectedness in lower

Table 1

Correlation Matrix of Content Factors for
Lower Division Classes (N = 155)

	Course Content Connectedness	Course Content Accuracy	Course Content Role	Course Content Others' Grade
Grade	-.03	.16*	-.04	-.03
Course Content Connectedness		-.14*	.71**	.48**
Course Content Accuracy			-.20*	-.08
Course Content Role				.62**

* $p < .05$
** $p < .01$

Table 2

Correlation Matrix of Social Factors for
Lower Division Classes (N = 155)

	Social Content Connectedness	Social Content Accuracy	Social Content Role	Social Content Others' Grade
Grade	-.21**	.08	-.15*	-.09
Social Content Connectedness		-.10	.74**	.51**
Social Content Accuracy			-.14*	-.04
Social Content Role				.56**

*$p < .05$
**$p < .01$

Table 3

Correlation Matrix of Content Factors for Upper Division Classes (N = 86)

	Course Content Connectedness	Course Content Accuracy	Course Content Role	Course Content Others' Grade
Grade	-.17*	.06	-.13	.01
Course Content Connectedness		-.20*	.74**	.53**
Course Content Accuracy			-.15	-.18*
Course Content Role				.72**

*p < .05
**p < .01

Table 4

Correlation Matrix of Social Factors for Upper Division Classes (N = 86)

	Social Content Connectedness	Social Content Accuracy	Social Content Role	Social Content Others' Grade
Grade	-.13	-.03	-.11	.10
Social Content Connectedness		-.20*	.63**	.41**
Social Content Accuracy			-.10	-.20*
Social Content Role				.63**

*p < .05
**p < .01

division classes and course content connectedness negatively correlated to grade. Social content connectedness in lower division courses had a somewhat stronger relationship ($r=-.21$, $p<.01$) than did course content connectedness in upper division courses ($r=-.17$, $p<.05$). Course content connectedness in lower division courses and social content connectedness in upper division courses were not significantly correlated to course grade. There does appear to be some relationship between student network activity and classroom success.

Chi-square analysis for four 3 x 3 contingency tables produced one statistically significant result between social connectedness in upper level classes and grade ($x^2=10.96$, $p<.03$). This analysis looked at three levels of social connectedness (high, medium and low) with three levels of course grade (above average, average, and below average). Distributions were such that average classroom performers were more likely to fall into medium levels of social content connectedness and less in low levels of social content connectedness. Above average performers were more likely to fall into the low social content connectedness categories than in the other two levels. Distributions for low performers were nearly random across social content connectedness categories.

The correlations and the one significant chi-square indicate an inverse relationship. The less connected a student is, the better are the probabilities for classroom success.

Research question #3 was directed at discovering the nature of the relationship between individual link accuracy and student performance. Only individual accuracy about links in course content lower division networks had a statistically significant positive correlation to grade ($r=.16$, $p<.05$). The positive correlations of individual accuracy about

links in both social content lower division networks and course content upper division networks to grade are non-significant, and the non-significant correlation between grade and accuracy about links in social content upper division courses is a negative correlation. No statistically signficant results were found at nominal level analysis. There is little, if any, relationship between link accuracy and student performance.

Research question #4 sought the relationship between the quality of information in a personal network and classroom success. None of the correlations between grade and course content-others' grade or social content-others' grade in either the upper or lower division courses were statistically significant. Nominal level analysis did detect one statistically significant relationship ($x^2=10.55$, $p<.03$) between social content-others' grade in upper division networks and final grade. What is more, the distributions suggest a linear relationship overcoming randomness with low grade students shifting to low grade others, moderate grade students also shifting from low others and high others to moderate others, and high grade students shifting from moderate others to high others. This leads us to question our procedures for this variable. There may be some relationship, but at this time, we can only conclude that there is no relationship between the quality of information received in a student's personal network and classroom performance.

Research question #5 sought differences between lower and upper division courses. A comparison of Tables 1 and 2 to Tables 3 and 4 is required.

In lower division courses, three of the eight correlations of network variables to student performance (displayed in the first rows of Tables 1 and 2) were statistically significant. Link accuracy about course content links was positively correlated (.16), social content connectedness was

negatively correlated (-.21), and social content network role was negatively correlated (-.15) to grade. These results suggest that more successful students can identify the sources of their information about course content and avoid involvement in the social network.

In upper division courses only one of the eight correlations between grade and network variables (displayed in the first rows of Tables 3 and 4) was statistically significant. Course content connectedness has a negative correlation to grade (-.17). The more successful student in the upper division courses limit involvement in the student network about the course material.

These results seem to indicate that lower division student networks are more related to classroom performance than upper division student networks. The net impact of this lower division relationship is to reduce classroom performance.

Research question #6 sought differences between course content networks and social content networks. This may be determined by a comparison of Tables 1 and 3 to Tables 2 and 4. In course content networks, grade is positively correlated to lower division link accuracy (.16) and negatively correlated to upper division connectedness (-.17). In social content networks, grade is negatively correlated with both lower division connectedness (-.21) and role (-.15). While connectedness appears to have a harmful influence on performance in both types of content networks, accurate perceptions of activity appeared to be more important in course content networks, and the nature of the connectedness, the role, appeared to be more important in social content networks. Social content networks are more correlated to grade in lower division courses than upper division courses.

Tables 5 and 6 about here

Table 5

Regression Analysis Results for Lower Division Classes (N = 155)

Variable	Multiple R	R Squared	Simple r
* 1. Social Content Connectedness	.209	.044	-.209
* 2. Course Content Connectedness	.305	.093	-.026
3. Course Content Accuracy	.330	.109	.157
4. Social Content Accuracy	.331	.110	.083
5. Social Content Others' Grade	.331	.110	-.086
6. Course Content Others' Grade	.331	.110	-.026
7. Course Content Role	.332	.110	-.043

Table 6

Regression Analysis Results for Upper Division Classes (N = 86)

Variable	Multiple R	R Squared	Simple r
* 1. Course Content Connectedness	.171	.029	-.171
2. Social Content Others' Grade	.244	.059	.095
3. Social Content Role	.268	.072	-.107
4. Course Content Accuracy	.275	.076	.056
5. Social Content Accuracy	.280	.079	-.027
6. Social Content Connectedness	.283	.080	-.125
7. Course Content Others' Grade	.283	.080	.009

* Best predictor(s) for the regression analysis

To answer Research question #7, a multiple regression using network factors as predictor variables and course grade as the criterion variable was conducted for lower division classes. Table 5 presents the results of this analysis. The eight network predictor variables (four social and four course content factors) explained 11% of the variance, with social content connectedness being the best predictor, explaining 4.4% of the variance. To determine if all eight of these variables individually made a significant contribution to the regression equation or if just one or several were meaningful, a statistical procedure described by Roscoe (1975, pp. 375-377) was used. This test of significance indicates whether the subsequent addition of predictor variables significantly improves the prediction of the criterion variable. Results indicated that the first two factors (social content connectedness and course content connectedness) were the best predictors. Together they explained 9.3% of the variance. Since both social and course content connectedness were negatively correlated with course grade, these results reveal that for lower division courses, the more a person is connected to others by social and course content information, the poorer the classroom performance.

Research question #8 was answered by conducting a multiple regression using network factors in the upper division courses. Table 6 presents the results of this analysis. The eight network predictors (four social and four course content factors) explained 8% of the variance. Again using the procedure prescribed by Roscoe (1975), it was dicovered that the first factor (course content connectedness) explained 2.9% of the variance and was the best predictor of course grade in upper division courses. The F ratio calculated to determine if the second variable of quality of social information (social-others' grade) significantly improved prediction was not significant ($F=2.67$, $df=1/84$, $p>.05$). Since content connectedness was negatively

correlated with course grade, this finding indicated that for upper division courses, the more a person talks to others about course content information, the poorer the classroom performance.

Discussion

Communication networks are often analyzed by describing members' positions in the structure in an attempt to assess the network's influence on individual behavior. In well structured systems, such as organizations, the roles most critical to the maintenance of the structure (linker roles) have been associated with high levels of performance, and roles least critical to the structure (isolates) are associated with poor performance. This pattern does not appear to be true in university classrooms. If students assume roles of limited importance to a network, their chances for success in a class appear to increase. Successful performance does not rely on centrally located contacts within a network.

The actual amount of individual activity in a network has also been the subject of analysis. Research generally concludes that more activity is associated with better performance. Again, this does not appear to be true in a university. Students with the best performance tend to be least connected. Scholarship may be a solitary activity, adversely affected by an increase in the number of communication relationships.

One explanation for these contradictory findings may be our definition of communication links. Recall that we required a link to be reciprocated for inclusion into our analysis and that unreciprocated links were regarded as overestimates of activity. This position was consistent with our own theoretical assumptions about the nature of networks in general and the volatile nature of student networks. As the Methods section noted, reciprocity was used as an indication of reliability and led us to discard

from 10-20% of the links initially estimated by students because they were unreciprocated and assumed to be unreliable.

Rice, Richards and Cavalcanti (1980) have already demonstrated that when over 10% of a given link population is discarded, significant differences in the final analysis may develop. Richards (1980), on the other hand, has noted the need for theoretical consistency and proposed a cognitive-constructivist model to networks similar to our own. Our own theoretical assumptions led us to treat perceptual data in a particular way. Although discarding as many unreciprocated links as we did may produce significantly different analyses than if we had not, our approach does claim a measure of reliability and would lead us to believe the networks we constructed from the reciprocated links are valid since they are consistent with our assumptions.

A second method of explaining the contradictory findings of our research is to note the differences between the types of networks studies in the past and the type of network studied here. We assume that student networks are inherently volatile due to the composition of its members and the nature of the information being processed. Our results differ, but they are not inherently contradictory.

Link accuracy and quality of information were not related to classroom performance. These variables may not, in fact, be important. Simply because someone is accurate about the potential for relational influence does not tell us whether one is in fact influenced or even desires to be influenced. The quality of information which may be communicated in a relationship does not tell us what actually was communicated. The nature of student relationships may simply be such that the potential for the influence of these two factors is not actualized without consideration for a level of activity or

connectedness. Activity may be the best predictor because of the intrinsic worth of activity in student relationships; however, link accuracy and quality of information may be more significant correlates in another type of network.

Social connectedness was the principle correlate in the lower level classes while course content connectedness was the princple correlate in the upper level classes. Recall that both correlations were negative. The newer members of a campus may have a greater need for affiliation, delaying a student's desire to obtain the intrinsic rewards of discovery inherent in his course material. As the student pursues this desire and attempts to construct more and more communicative relationships, performance in the course suffers.

The upper classman may desire to clarify course material or simply to share an overload. The energy demands or maintaining an ever increasing number of relationships may detract from his individual effort, thus reducing his level of performance.

Neither scenario may be accurate, but the results of our research demonstrate that the university students' scholastic success is adversely affected by increasing involvement in one or more networks. Involvement in one of these temporary volatile social structures will not improve individual performance.

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